BULK SPECIFIC GRAVITY AND DENSITY OF COMPACTED BITUMINOUS MIXTURES USING AUTOMATIC VACUUM SEALING METHOD

ASTM D 6752

GLOSSARY

Specific Gravity -- the ratio of the weight in air of a volume of material to weight in air of an equal volume of water.

SCOPE

The compaction of HMA in the field and in the laboratory is an important characteristic to be determined for mixture quality control. The bulk specific gravity of compacted specimens (G_{mb}) can be determined on pavement cores or laboratory compacted specimens. The value is used to determine air voids (V_a) and may be used for comparison between roadway compaction tests and laboratory compacted specimens.

Compacted specimens with significant surface texture and interconnected voids require sealing the surface to obtain an accurate measurement of the G_{mb}. Open graded mixture with 15-20% air voids is an example of a mixture with significant interconnected voids that require sealing. The use of a vacuum sealing device with a plastic bag to seal the surface of the compacted laboratory or field specimen is one method to accurately measure the G_{mb} of open graded mixtures. An additional advantage of this procedure is that the sample is not destroyed and may be used for additional tests.

The Gmb is determined by measuring the volume of the specimen by displacement when submerged in water. The specimen dry weight, weight of the sealed specimen submerged in water, and the weight of dry sealed specimen are determined to calculate the G_{mb}.

SUMMARY OF TEST

Apparatus

Balance, general purpose class G_2 (AASHTO M 231)

Water bath, equipped with overflow outlet

Cushioned holder

Vacuum Measurement Gage, capable of reading to 29.8 in. Hg (3 TORR) of vacuum

Plastic bags, capable of withstanding sample temperatures of up to 70°C, puncture resistant, impermeable to water, containing no air channels for evacuation of air, and will not adhere to asphalt film

Specimen sliding plate

Bag cutting knife

Granite standard cylinder, 6 in. (150 mm) by 3 in. (75 mm)

Vacuum chamber, capable of evacuating a sealed and reclosed chamber to 29.5 in. Hg (100 kPa) vacuum in less than 60 seconds.

Vacuum Chamber

Test Specimens

The diameter of the specimen shall be at least equal to four times the maximum size of aggregate, and the thickness shall be at least one and one half times the maximum size of aggregate.

Specimens shall be free of foreign materials, such as seal coat, tack coat, soil, paper, or foil. When any of these materials are visually evident they shall be removed.

PROCEDURE -- WEIGHT OF UNSEALED SPECIMEN

Laboratory Prepared Specimen

Weigh the specimen after it has cooled to room temperature, and record the weight (A) to the nearest 0.1g.

Cores and Specimens Containing Moisture

Dry the specimen to constant weight. Constant weight is defined as less than 0.05% change in weight between consecutive drying intervals.

PROCEDURE -- WEIGHT OF SEALED SPECIMEN

1. Select an appropriate size bag as follows:

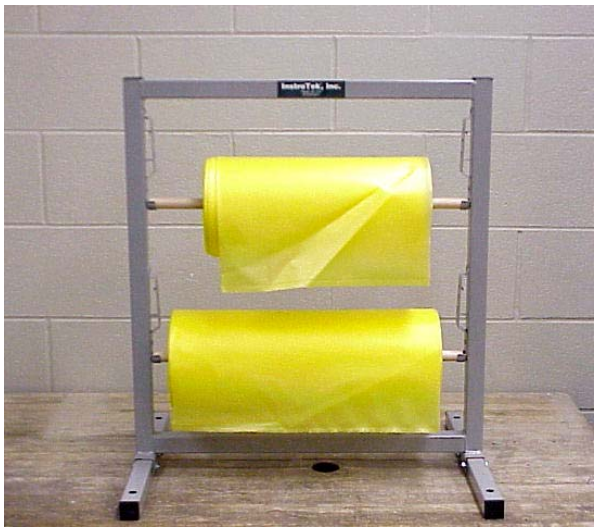
   Smaller Bag (min. opening of 9.25 in. (325 mm) and max. opening of 10.25 in. (260 mm))

   a) all 4 in. (100 mm) diameter samples
   b) all 6 in. (150 mm) diameter and 2 in. (50 mm) or less thickness samples

   Larger Bag (min. opening of 14.75 in. (375 mm) and max. opening of 15.5 in. (394 mm))

   a) all 6 in. (150 mm) diameter and greater than 2 in. (50 mm) thickness samples

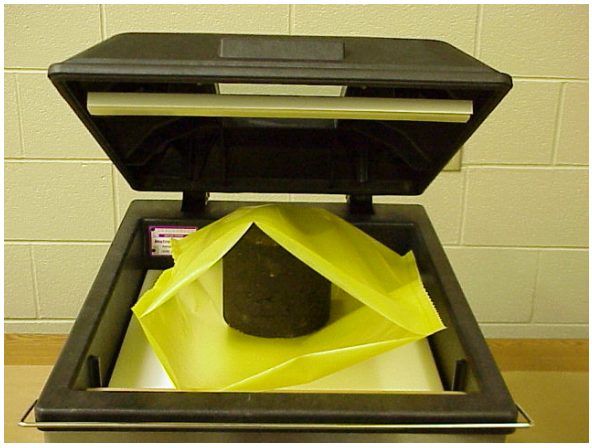
   Manufacturer's Recommendation -- all samples that weigh more than 5500 grams or samples that are abnormally shaped.



Plastic Bags

2. Place a bag inside the vacuum chamber on top of the specimen sliding plate.

3. Open the bag and gently place the specimen in the bag on top of the specimen sliding plate without puncturing the bag.



Specimen in Bag

4. Allow the vacuum chamber to remove the air from the chamber and bag. The vacuum chamber automatically seals the bag once the air is removed.

5. Exhaust air into the chamber until the chamber door opens, which indicates atmospheric pressure within the chamber.

6. Remove the sealed sample from the vacuum chamber. The sample should be handled with extreme care to prevent puncturing the bag.

Sealed Sample

7. Weigh the sealed specimen in air, and record weight (B) to the nearest 0.1g.

8. Weigh the sealed specimen in a water bath at 77°F (25°C) and record weight (E) to the nearest 0.1g. The duration of the test from initiating the vacuum extraction to weighing the specimen in water shall not exceed five minutes.

Weighing in Water

9. Remove the specimen from the bag and weigh the specimen. Subtract the weight of the dry specimen in air (A) from the weight of the specimen. This weight is considered the amount of water that is absorbed. If the weight of the specimen removed from the bag is greater than the weight of the dry specimen in air by more than 5g, the test is considered invalid.

Calculations

Calculate the bulk specific gravity of the specimen as follows:

Water at 77 ± 1.8°F (25 ± 1°C)

$$G_{mb} = \frac{A}{B - E - \frac{B - A}{F_t}}$$

where:

A = weight of dry specimen in air, g
B = weight of dry, sealed specimen, g
E = weight of sealed specimen in water, g (weight of absorbed water is subtracted)
Ft = apparent specific gravity of plastic sealing material at 77°F, provided by manufacturer

Calculate the density of the specimen as follows:

Density = G_{mb} x γ

where:
γ = density of water at 77°F (25°C) (62.4 lb/ft^3, 997.0 kg/m^3, 0.997 g/cm^3)

Example

Given:
Weight of dry specimen in air (A) = 4857.3 g
Weight of dry, sealed specimen (B) = 4909.0 g
Weight of sealed specimen in water (E) = 2811.0 g
Apparent specific gravity of bag (F_t) = 0.710
Weight of specimen after water submersion = 4871.6 g

$$\text{Absorbed Water, \%} = \frac{4871.6 - 4857.3}{4857.3} \text{ x } 100$$

$$= 0.3\,\%\,(\text{Valid Test} < 2\%)$$

Adjusted wt. in water = 2811.0 - (4871.6 - 4857.3)

$$= 2796.7 \text{ g}$$

$$\text{Bulk Specific Gravity} = \frac{4857.3}{4909.0 - 2796.7 - \left(\frac{4909.0 - 4857.3}{0.710}\right)}$$

$$= \frac{4857.3}{2112.3 - 72.8}$$

$$= 2.382$$